STANDARD

PROCEDURE

G-6200

PROGRAM: Standard Work Aids

PROJECT: Cost Estimating

SUBJECT: Independent Cost Estimate (ICE) by Cost Accounting Branch (CFG) for an Independent Review Team (IRT)

Authorized by: _____
Charlotte Y. diCenzo, Cost Accounting (CFG) Branch Chief

Dated on _____

Total Pages 13

1.0 PURPOSE

1.1 The Independent Cost Estimate (ICE) is developed by an independent review team (IRT) (as opposed to the program/project team) and focuses on providing cost estimates as a result of questioning assumptions and identifying and quantifying technical and programmatic risks, risk mitigation strategies, and reserve strategies. The ICE from one of these reviews may result in a delta to the program's baseline estimate or a new estimate.

2.0 SCOPE

2.1 This independent review team (IRT) interrelates with the program/project team in a manner sufficient to conduct a cost estimate that is allows the IRT to form a conclusion expressing the cost estimating team's determination regarding the reasonableness of the program office estimates.

3.0 REFERENCE DOCUMENTS

3.1 **NASA Cost Estimating Handbook 2006, Appendix H, Page H-1**

3.2 **NASA Procedural Requirements (NPR) 7120.5C NASA Program and Management Processes and Requirements**

3.3

4.0 DEFINITIONS AND ACRONYMS (Source: NPR 7120.5 C NASA Program and Project Management Processes and Requirements)

ACE – Advocacy Cost Estimate, also known as Life Cycle Cost Estimates (LCCs) Cost estimators, as a member of the product or program design team, prepare ACEs. These LCC estimates are based on translating the technical and design parameter characteristics into cost estimates using established cost estimating methodologies. Iterative and on-going reviews are conducted with members of the technical team during the design process until the cost estimator and the program/project management team is confident that the cost estimate accurately reflects the baseline program/project in terms of design requirements, technical capabilities, management structure, and operational scenarios. The ACE then becomes the basis for the budget baseline for the program/project.

CADRe – The CADRe is a hybrid requirement that is unique but equivalent to two previously used DRDs (Data Requirement Descriptions) - the Cost Analysis Requirement Description (CARD) and Life Cycle Cost Estimate (LCCE) by combining their key elements in a single, coordinated report. (NASA Cost Estimating Handbook 2006, Appendix H, Page H-1)

EAA – Enterprise Associate Administrator

IRT – Independent Review Team

ICE – Independent Cost Estimate, prepared by independent review teams.

IPAO – Independent Program Assessment Office – The organization responsible

for scheduling, organizing, and conducting the NAR, IIR, and IA's for programs/projects reporting to the Agency PMC

CEWG - Cost Estimating Work Group

CAO – Cost Analysis Offices. Organizationally these may be in different functional organizations the Center Operations Office (COO), Chief Financial Officer Office (CFO Office), Systems Management Office (SMO) Resource management Office (RMO), or Business Management Office (BMO)

CEC – Cost Estimating Community

GMPC – Governing Program Management Council (GPMC) – The highest level PMC that has the responsibility to regularly review a program or project.

IIR – Independent Implementation Review - An assessment conducted by experts outside the advocacy chain, of the status of the commitments (performance, cost, and schedule) in a PCS, Program Plan, and/or Project Plan at approximately annual intervals during implementation.

IV&V – Independent Verification and Validation – A process whereby the products and processes of the software development life-cycle phases are reviewed, verified, and validated by an organization that is neither the developer nor the purchaser of the software, which is defined by two parameters – technical independence and managerial independence. Technical independence engages personnel who are not involved in the development activities. Managerial independence requires responsibility for the IV&V effort to be vested in an organization separate from the organization responsible for development.

Life-Cycle Cost (LCC) The total of the direct, indirect, recurring, nonrecurring, and other related expenses incurred, or estimated to be incurred , in the design, development, verification, production, operation, maintenance, support and retirement of a system over its planned life.

NAR – Non-Advocate Review – the analysis of a proposed program or project by a (non advocate) team composed of management, technical, and budget experts (personnel) from outside the advocacy chain of the proposed program or project. It provides Agency management with an independent assessment of the readiness of the program/project to proceed into implementation. (WBS Baseline is defined as the WBS used and approved at this review.) From the NASA Cost Estimating Handbook 2002 a NAR is the approval sub-process for all programs and selected projects. All must include a NAR, which provides an independent verification of a candidate program/project/s plans, LCC Status, and readiness to proceed to the next phase of the program's life cycle. A NAR is conducted by a team comprised of highly knowledgeable specialists from organizations outside the advocacy chain of the program/project being reviewed.

PMC – Program Management Council (PMC) One of the hierarchy of forums, composed of senior management, that assesses program and project planning and implementation and provides oversight and direction as appropriate. These are established at the Agency, Enterprise, Center and lower levels.

WBS- Work Breakdown Structure. (Reviewed for accuracy, completeness and any needed changes. Goal is to make sure that all elements are captured.)

5.0 RESPONSIBILITIES

5.1 **Agency Chief Financial Officer (CFO).** The NASA CFO at Headquarters (Code B) is responsible for: • Developing overall agency policies, guidelines, and procedures for budget administration, financial reporting, and financial management systems; • Formulating policies governing how financial services are provided and managed; • Establishing and maintaining accounting principles, procedures, and systems; • Developing policies and standards for cash and credit management; and • Maintaining liaisons with the Office of Management and Budget (OMB), the Department of Treasury, the General Accounting Office (GAO), and various Congressional committees with Agency financial management oversight activities.

5.2 The **NASA CFO Council** assists the NASA CFO in the performance of these responsibilities. The CFO Council includes key Agency financial and resources management officials and has been established to strengthen coordination and communication regarding all financial and resources (budget) management matters.

5.3 **Independent Program Assessment Office (IPAO).** The IPAO is a Headquarters office located at LaRC. The IPAO's role in cost estimating is to provide leadership and strategic planning for the cost estimation core competency by: • Interfacing with the Agency CFO and the Office of the Chief Engineer (Code AE) at NASA Headquarters regarding cost analysis requirements and processes, • Providing instruction on cost tool use, • Developing specialized cost tools, • Ensuring consistent, high-quality estimates across the Agency, • Fostering a "pipeline" of competent NASA cost analysts, • Providing independent, non-advocate cost estimates and cost-benefit analyses, and • Chairing the Cost Estimating Working Group and the annual NASA Cost Symposium Workshop.

5.4 **Cost Analysis Offices (CAOs).** The CAOs at each NASA Center provide analysis, independent evaluations, and assessments of Center programs and projects, including programs delegated to the Center as lead Center. Organizationally, many of the CAOs are located in the System Management Office (SMO). Some CAOs are intrinsically tied into technically oriented technology assessment at component, sub-system, system and architecture levels to perform cost and project assessments. Other CAOs are located under the Center's CFO, Resource Management Office (RMO), or Business Management Office (BMO). Although the functions and responsibilities of the CAOs may vary slightly from Center to Center due to differences in the mission and organizational structure, their role is generally to: • Serve as the Center's focal point for

independent cost estimating and analysis for programs and projects, • Support NARs, IARs, and IAs of Center programs and projects, • Ensure that programs and projects develop and implement management practices, policies, processes, and procedures that are consistent with the NPR 7120.5, NASA Program and Project Management Processes and Requirements, • Promote the use of advanced project management analytical tools and processes for improving cost, LCC, and schedule estimating and analysis capabilities, • Maintain contacts with the cost estimating offices at other NASA Centers (through the CEWG and other forums) to coordinate and promote consistent cost and schedule functions, processes, approaches, and analyses across all NASA Centers, and • Provide cost analysis expertise to the IPAO to support independent reviews as requested.

6.0 METHODS, METHODOLOGIES, REQUIREMENTS OR SPECIFICATIONS

6.1 Methodology -Foundation of the Cost Estimate

6.1.1 Cost estimates serve different purposes. Each estimate has a different customer and a slightly different focus, which are important to recognize when beginning an estimate. However, the estimating process itself does not vary greatly between the different types of estimates. It is important to build a solid foundation before the estimate process is initiated. There are four critical elements to any estimate that need to be understood and agreed upon between the cost estimator and the decision-maker before a methodology can be chosen and an estimate can be developed. As shown in Exhibit 4-1 of the NASA Cost Estimating Handbook, the four elements are resources, data, schedule and expectations. An estimator conducting any estimate, from the back of an envelope to a formal estimate, should consider these factors before choosing a methodology to conduct the estimate.

6.1.2 Resources

6.1.2.1 How many people are required to conduct the estimate?

6.1.2.2 How many people are available to conduct the estimate?

6.1.2.3 What is the budge required to conduct the estimate?

6.1.2.4 What is the available budget to conduct the estimate?

6.1.3 Data

6.1.3.1 What data do you need?

6.1.3.2 Is the data readily available?

6.1.3.3 If the data is not readily available what are your alternatives?

6.1.3.4 Are the organizations you need to collect the data from cooperative and accessible?

6.1.3.5 Are non-disclosure agreements required?

6.1.4 Schedule+

6.1.4.1 How long have you been given to complete the estimate?

6.1.4.2 How long do you need to compete the estimate, given the available resources and data?

6.1.4.3 Do you have the resources needed to conduct the estimate within the allotted schedule?

6.1.4.4 Do you have the time to collect the required data and analyze the data?

6.1.5 Expectation

6.1.5.1 What is your expectation of the estimate?

6.1.5.2 What is the expected outcome or usage of the estimate (based on estimate type)?

6.1.5.3 What is the decision maker's expectation of the estimat?

6.1.5.4 What is the team expectation of the estimate?

6.1.5.5 What are the agency wide expectation of the estimate outcome and usage?

7.0 Requirements

7.1 CFO Certification Requirements –The threshold for NASA CFO Certification of an ICE is over $150m for programs moving from Phase A to Phase B. So if an ICE is required, a CADRe is required: however, programs less than 150m that require an ICE outside of the Congressional statutory CFO certification of Phase A to B also require a CADRe. (NASA Cost Estimating Handbook 2006, Appendix H, Page H-1). The following is a copy of the Specific Authorization Language

7.1.1 **Language in the Authorization Bill for FY 2001**

SEC. 301. REQUIREMENT FOR INDEPENDENT COST ANALYSIS.

(a) REQUIREMENT.—Before any funds may be obligated for Phase B of a project that is projected to cost more than $150,000,000 in total project costs, the Chief Financial Officer for the National Aeronautics and Space Administration shall conduct an independent life-cycle cost analysis of such project and shall report the results to Congress. In developing cost accounting and reporting standards for carrying out this section, the Chief Financial Officer shall, to the extent practicable and consistent with other laws, solicit the advice of expertise outside of the National Aeronautics and Space Administration.

(b) DEFINITION.—For purposes of this section, the term ''Phase B'' means the latter stages of project formulation, during which the final definition of a project is carried out and before project implementation (which includes the Design, Development, and Operations Phases) begins.

8.0 Evaluation Methodology [AKA IPAO Cost Estimate Sufficiency Report (SR)]

IPAO Cost Estimate Sufficiency Review Checklist
Version 1a

This is a checklist to review project office cost estimate for reasonableness, completeness, consistency, and compliance with generally accepted estimating processes. The end result of the sufficiency review will provide decision makers with an assessment on the quality of the cost estimate.

Appendix A is the sample report. Appendix B is a list of detail questions and it will serve as a repository of other questions and "lessons learned" matters.

Standards we look for:

Traceability. Information presented in a traceable fashion containing supporting documentation and technical data. IPAO cost estimator must be able to trace with the given information.

Reasonableness. Information presented in a logical manner with appropriate analogies and cost estimating relationships (CERs).

Soundness. Information, assumptions, and recommendations presented must be sound arguments. IPAO cost estimator will carefully consider expert judgments or assumptions.

Verification. Information presented must be verifiable by the IPAO cost estimator. The IPAO cost estimator will check databases that were used to verify the technical parameters on the cost elements.

Validity. Information presented must be logically correct, justifiable, and well-grounded. The IPAO cost estimator will review the groundrules and assumptions.

Accuracy/Consistency. Information presented is well organized, cohesive, supportable, and easily understood.

Completeness. Information presented must contain all necessary data, assumptions, and pertinent information.

How we assess cost estimates:

Receive the project cost estimate from the project office.

What constitutes "project cost estimate": documentation that contains the numeric tables with all supporting narrative (in softcopy).

Check the administrative information.

- Who prepared the estimate?
- For what purpose was the project office estimate generated?
- How much effort (staff months) did it take to do the estimate?
- What was the cost estimating schedule? Is this estimate a new estimate or an update of a prior estimate?
- Has anyone else reviewed this estimate or the prior estimate and what were the findings?

Review of the presence of the cost estimate documentation. This is to verify that in fact there are adequate "materials" to conduct the sufficiency review. Is the documentation organized according to the WBS—if not, a logical manner that will provides structure for the IPAO cost estimator to follow.

- Are prior costs documented?
- Are the narratives explaining the estimating methodologies understandable?
- Are there pertinent historical information and project funding data?
- Are there supporting data or documentation available for those elements requiring further verification?
- Are the WBS definitions available?
- Can the IPAO cost estimator "replicate" what was done in the project office estimate—from the documentation?

Assuming a reasonable level of documentation is present, the next step is to conduct the traceability from the final cost estimate "rollup'ed" number to the appropriate level that show the basis of the estimate. The IPAO cost estimator will select a cost element and "drill down" to the basis of the estimate. The drill down process depends on the cost element and how it is "bucketed" and "estimated." Generally, the estimator will literarily track the number from one spreadsheet or chart to another and in the process "decompose" the summation number until we reach a satisfactory level where the estimate is understood.

As a guideline, the IPAO cost estimator will target the high cost, high risk, and high interest cost elements. Depending upon the project, this may fall into the 80/20 rule, where 80% of the cost resides in 20% of the cost elements.

Which cost elements are "pass through" elements?
Once the cost elements are selected, the IPAO cost estimator will drill down each element tailored to its component or system.

There are many questions an estimator can ask to understand the cost estimate. These are suggested questions to be asked in a drill down exercise—this is not an inclusive list:

- Are the costs rational to prior actual costs?
- Are the ground rules and assumptions reasonable?

- Are the learning curve (if applicable) and slopes reasonable?
- Were historical data used?
- Were correct inflation rates used?
- Were appropriate methods used? Is the estimate reflecting analogies and databases that are within realm of reasonableness, such as technology, platforms, etc?
- Are the data points/range used in the cost estimate relevant?
- Are all pertinent costs included?
- Are costs time-phased over the fiscal years?
- Both inflated and non-inflated dollars?
- What is the method of time phasing the point estimate?
- Is the project schedule consistent with cost estimate schedule used in the phasing?
- Were analogous direct and overhead rates used?
- Did the estimate capture applicable full cost?
- Is appropriate cost risk analysis performed? Did the estimate capture the risks?
- Did the estimate cover the "scope" of the program in review?
- Did the estimate identify which cost elements were estimated and pass-throughs?
- Did the estimate provide a cumulative distribution curve (S-curve)?

The IPAO cost estimate will submit an IPAO Sufficiency Review Report (see appendix A). The report will consist of:

- Executive summary (1-page) which will provide the cost estimate confidence level, via the Cost Readiness Level (CRL) and the rationale accompanying the assessment.

- Detail report

Appendix A

IPAO Cost Estimate Sufficiency Report (SR)

PART ONE:

Project Name:

IPAO Reviewer:

Purpose of the SR: (example) This SR was done in conjunction with the project NAR.

Executive Summary:

1. Cost Readiness Level (CRL) of the cost estimate:
2. Bullet summary of the SR.

PART TWO:

Detail report (the level depends on the scope of the cost estimate)

- Traceability. Assessment and justification.
- Reasonableness. Assessment and justification.
- Soundness. Assessment and justification.
- Verification. Assessment and justification.
- Validity. Assessment and justification.
- Accuracy/Consistency. Assessment and justification.
- Completeness. Assessment and justification.

Appendix B: (This list will be expanded as we gather more questions.)

Risk related questions:

1) Have costs for discrete, identified risks been captured?
2) How were inputs to cost-risk models (e.g., @Risk) developed?
3) Were engineers consulted in the definition of the level of risks?
4) Was CER, technical and correlation risk captured?
5) Was both probabilistic and discrete risk analysis performed?
6) Were the cost-risk distributions used justifiable?
7) Were provisions for unknown-unknowns made in the estimate?
8) Was schedule risk quantified along with cost-risk?
9) Can the cost-risk analysis answer the questions: How many dollars are included to cover discrete risks?
10) What are the risky WBS elements?
11) What is the likelihood of an overrun?

9.0 Schedule relationships Per Headquarters IPAO Anita Thomas (757) 864-9119 March 5, 2004. To be used in conjunction with MsProject File Health check Filters.mpp and Health Check form .xls

Below are filters and sample results from a project plan that was filtered for an IPAO Sufficiency Review.

Project Name:

	7-11-02 Check	
Schedule Status		
Current Start	**4/1/2002**	
Current Finish	**6/12/2003**	
Total Project Duration	**301d**	
Remaining Work Duration	**239d**	
Status Date	**6/27/2002**	
Task & Milestone Count	**Count**	**% of Total**
Total Tasks & Milestones	**97**	
Completed Tasks & Milestones	**15**	**15%**
To Go Tasks & Milestones	**82**	**85%**

Tasks & Milestones Without Predecessors	**1**	**1%**
Tasks & Milestones Without Successors	**10**	**12%**
Constraints (other than ASAP)	**3**	**4%**
Summaries with Logic Ties	**7**	**9%**
Total Float > 25% of Remaining Duration	**3**	**4%**
Tasks & Milestones Needing Status (or behind schedule w/o new forecast dates)	**2**	**2%**
Actuals after Status Date	**0**	**0%**
Tasks marked as Milestones	**0**	**0%**
Tasks & Milestones on Critical Path	**62**	**76%**

10.0 Required Documentation for a NAR (Non-Advocate Review) Per Headquarters IPAO Michelle Calloway Nov 26, 2003.

8.1.1 Purpose of Cost Estimate

8.1.2 Program background and system description

8.1.3 Program schedule

8.1.4 Scope of cost estimate

8.1.5 Ground rules and assumption

8.1.6 WBS

8.1.7 Training

8.1.8 Independent Verification and Validation (IV&V)

8.1.9 The data, data sources, and normalization procedures

8.1.10 Labor rates and hours, content, and how they were developed

8.1.11 Material requirements and subcontracts

8.1.12 Methodology for any applicable cost improvement curves

8.1.13 Details regarding the basis of estimate for SW development for the simulations and models:

8.1.13.1 Relevance to the system/program

8.1.13.2 Inputs/outputs

8.1.13.3 Calibrations performed

8.1.14 Inflation indices used and time phasing details

8.1.15 Detailed description of judgments applied by estimator(s)

8.1.16 Any details of risk and confidence analysis

8.1.17 The conclusion resulting from the estimate

8.1.18 A conclusion expressing the cost estimating teams determination regarding the reasonableness of the program office estimates.

9.0 FLOW CHARTS/MAPS

10.0 PROCEDURE

11.0 METRICS

12.0 OTHER DOCUMENTS, PROCEDURES OR FORMS RELEVANT TO THIS PROCEDURE

13.0 NECESSITY

13.1 Independent Cost Estimates are developed by the cost analyst members of an independent review team in order to provide program/project management with the review teams assessment of how realistic the project's life cycle costs are.

14.0 QUALITY RECORDS

15.0 FORMS